6.13.6.1.4c Flange Splices

Revise as follows:

At the strength limit state, splice plates and their connections on ~~the controlling~~ flange<u>s</u> shall be proportioned to provide a minimum resistance taken as the design stress, F_{cf}, times the smaller effective flange area, A_e, on either side of the splice, where F_{cf} is defined as:

~~$$F_{cf} = \frac{\left(\left|\frac{f_{cf}}{R_h}\right| + \alpha\phi_f F_{yf}\right)}{2} \geq 0.75\alpha\phi_f F_{yf}$$~~

$$\underline{F_{cf} = \alpha\,\phi_f\,F_{yf}} \qquad (6.13.6.1.4c\text{-}1)$$

in which:

A_e = effective area of the flange (in.^{2}). For compression flanges, A_e shall be taken as the gross area of the flange. For tension flanges, A_e shall be taken as:

$$A_e = \left(\frac{\phi_u F_u}{\phi_y F_{yt}}\right) A_n \leq A_g \qquad (6.13.6.1.4c\text{-}2)$$

where:

~~f_{cf} = design maximum flexural stress due to the factored loads at the midthickness of the controlling flange at the point of splice (ksi)~~

~~R_h = hybrid factor specified in Article 6.10.1.10.1. For hybrid sections in which F_{cf} does not exceed the specified minimum yield strength of the web, the hybrid factor shall be taken as 1.0~~

α = 1.0, except that a lower value equal to (F_n/F_{yf}) may be used for flanges where F_n is less than F_{yf}

ϕ_f = resistance factor for flexure specified in Article 6.5.4.2

F_n = nominal flexural resistance of the flange (ksi)

F_{yf} = specified minimum yield strength of the flange (ksi)

ϕ_u = resistance factor for fracture of tension members as specified in Article 6.5.4.2

ϕ_y = resistance factor for yielding of tension members as specified in Article 6.5.4.2

A_n = net area of the tension flange determined as specified in Article 6.8.3 (in.^{2})

C6.13.6.1.4c

Delete the 3rd paragraph:

~~The controlling flange is defined as either the top or bottom flange for the smaller section at the point of splice, whichever flange has the maximum ratio of the elastic flexural stress at its <u>extreme fiber</u> midthickness due to the factored loads for the loading condition under investigation to its factored flexural resistance. The other flange is termed the noncontrolling flange. In areas of stress reversal, the splice must be checked independently for both positive and negative flexure. For composite sections in positive flexure, the controlling flange is typically the bottom flange. For sections in negative flexure, either flange may qualify as the controlling flange.~~

Revise the 5th paragraph as follows:

~~Eq. 3 defines a design stress for the noncontrolling flange at the strength limit state. In Eq. 3, the flexural stress at the midthickness of the noncontrolling flange, is concurrent with the stress in the controlling flange, is factored up in the same proportion as the flexural stress in the controlling flange in order to satisfy the general design requirements of Article 6.13.1. However, as a minimum, the factored-up stress must be equal to or greater than 0.75α $\phi_f F_{yf}$.~~

Delete the 7th paragraph:

~~Since flanges of hybrid girders are allowed to reach F_{yf}, the applied flexural stress at the midthickness of the flange in Eqs. 1, 3 and 5 is divided by the hybrid factor, R_h, instead of reducing F_{yf} by R_h. In actuality, yielding in the web results in an increase in the applied flange stress. When the flange design stress is less than or equal to the specified minimum yield strength of the web, R_h is taken equal to 1.0 since there is theoretically no yielding in the web. The load shedding factor, R_b, is not included in these equations since the presence of the web splice plates precludes the possibility of local web buckling.~~

Revise the 10th paragraph as follows:

A_g = gross area of the tension flange (in.^{2})
F_u = specified minimum tensile strength of the tension flange determined as specified in Table 6.4.1-1 (ksi)
F_{yt} = specified minimum yield strength of the tension flange (ksi)

~~Splice plates and their connections on the noncontrolling flange at the strength limit state shall be proportioned to provide a minimum resistance taken as the design stress, F_{ncf}, times the smaller effective flange area, A_e, on either side of the splice, where F_{ncf} is defined as:~~

~~Revise Eq. (6.13.6.1.4c-3) as follows:~~

$$\cancel{F_{ncf} = R_{cf}\left|\frac{f_{ncf}}{R_h}\right| \geq 0.75\alpha\phi_f F_{yf}} \qquad \cancel{(6.13.6.1.4c\text{-}3)}$$

~~where:~~

~~R_{cf} = the absolute value of the ratio of F_{cf} to f_{cf} for the controlling flange~~

~~f_{ncf} = flexural stress due to the factored loads at the midthickness of the noncontrolling flange at the point of splice concurrent with f_{cf} (ksi)~~

~~R_h = hybrid factor specified in Article 6.10.1.10.1. For hybrid sections in which f_{cf} does not exceed the specified minimum yield strength of the web, the hybrid factor shall be taken as 1.0~~

At the strength limit state, the design force in splice plates subjected to tension shall not exceed the factored resistance in tension specified in Article 6.13.5.2. The design force in splice plates subjected to compression shall not exceed the factored resistance, R_r, in compression taken as:

(no change to Eq. 4)

For the box sections cited in this article, longitudinal warping stresses due to cross-section distortion can be significant under construction and service conditions and must therefore be considered when checking the connections of bolted flange splices for slip and for fatigue. The warping stresses in these cases can typically be ignored in checking the top-flange splices once the flange is continuously braced. The warping stresses can also be ignored when checking splices in both the top and bottom flanges at the strength limit state. For these sections, St. Venant torsional shear must also be considered in the design of box-flange bolted splices at all limit states. St. Venant torsional shears are typically neglected in top flanges of tub sections once the flanges are continuously braced. The bolts for box-flange splices may be designed for the effects of the torsional shear using the traditional elastic vector method that is typically applied in the design of web splices. Depending on the limit state under investigation, the shear on the flange bolt group is assumed caused by either the flange force due to the factored loads, or by the appropriate flange design force, as applicable. The moment on the bolt group is taken as the moment resulting from the eccentricity of the St. Venant torsional shear due to the factored loads, assumed applied at the centerline of the splice. At the strength limit state, a design torsional shear <u>due to factored loads</u> should be used~~, which can be taken as the torsional shear due to the factored loads multiplied by the factor, R_{cf}, from Eq. 3~~. The box-flange splice plates in these cases should also be designed at the strength limit state for the combined effects of the calculated design shear and design moment acting on the bolt group.

Revise the 11th paragraph as follows:

In cases for straight girders where flange lateral bending is deemed significant, and for horizontally curved girders, the effects of the lateral bending must be considered in the design of the bolted splices for discretely braced top flanges of tub sections or discretely braced flanges of I-sections. The traditional elastic vector method may also be used in these cases to account for the effects of flange lateral bending on the design of the splice bolts. The shear on the flange bolt group is assumed caused by the flange force, calculated as described in the preceding

Revise Eq. (6.13.6.1.4c-5) as follows:

$$F_s = \frac{f_s}{R_h} \quad (6.13.6.1.4c\text{-}5)$$

where:

f_s = maximum flexural stress due to Load Combination Service II at the extreme fiber ~~midthickness~~ of the flange under consideration for the smaller section at the point of splice (ksi)

R_h = hybrid factor specified in Article 6.10.1.10.1. For hybrid sections in which f_s in the flange with the larger stress does not exceed the specified minimum yield strength of the web, the hybrid factor shall be taken as 1.0.

paragraph. The flange force is calculated without consideration of the flange lateral bending. The moment on the bolt group is taken as the flange lateral bending moment due to the factored loads. At the strength limit state, a design lateral bending moment due to the factored loads should be used~~, which can be taken as the lateral bending moment due to the factored loads multiplied by the factor, R_{cf}, from Eq. 3~~. Splice plates subject to flange lateral bending should also be designed at the strength limit state for the combined effects of the calculated design shear and design moment acting on the bolt group. Lateral flange bending can be ignored in the design of top flange splices once the flange is continuously braced.